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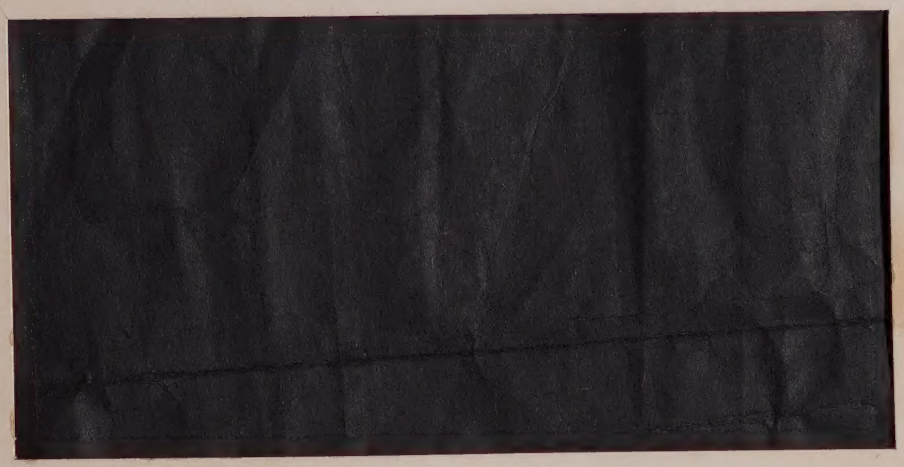

Thermo Electric Co., Inc.

SADDLE BROOK, NEW JERSEY

THERMO-ELECTRIC CO., INC., SADDLE BROOK, N. J.

OPERATION AND MAINTENANCE INSTRUCTIONS

MULTI-POINT CONTROLLER
MODEL 80215 (Potentiometer Circuit)

MODEL 80216 (Bridge Circuit)

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1-0 DESCRIPTION

1-1 Introduction

This manual contains all the information normally required to operate and maintain the Model 80215 and 80216 Multi-Point Controllers. Should you require additional information, contact your local Thermo-Electric Applications Engineer or Thermo-Electric's main office in Saddle Brook, N. J. We will be happy to be of assistance.

1-2 Application

For clarity, this manual will cover the operation of the instrument as used with a thermocouple transducer. The instrument may be supplied with either a potentiometer or resistance bridge measuring circuit. The potentiometer instruments are used with transducers such as thermocouples that generate a millivolt signal. The resistance bridge instruments are used with sensors such as resistance temperature detectors and strain gauges that offer a change in resistance. For variations on construction, operation and calibration when using the controller with resistance or millivolt DC output transducers other than the thermocouple, refer to the addendum.

1-3 Description

The Multi-Point Controller is a highly sensitive and accurate electronic instrument which measures and controls the temperatures of 10 individual processes. The thermocouple inputs are received through a set of input terminals located in the rear compartment of the instrument case. The inputs are sequentially scanned and compaired to setpoint levels previously determined by the operator. Based on these comparisions, the instrument automatically energizes or de-energizes the process control members by providing relay closures across 10 sets of double throw contracts, located in the rear compartment of the instrument. 10 white lamps on the front panel sequentially illuminate to indicate scanning position, and 10 red lamps indicate the condition of the processes (above or below setpoint level). 10 knobs are provided on the front panel for adjusting the setpoint levels on the 5 horizontal scales. A power on lamp, on-off switch, scanning on-off switch and manual advance push-button are also included on the front panel.

A constant voltage supply circuit provides a standard voltage for the measuring circuit and eliminates the need for a standard cell, battery, and standardization of the battery circuit.

The instrument is contained in a steel case which may be mounted in a standard 19 inch wide relay rack panel. The entire front panel and instrument chassis roll out of the case for making calibration adjustments and performing maintenance. The instrument may be removed entirely from the case, if desired, leaving the case undisturbed in its panel cut-out.

1-4 Specifications

Accuracy: ± 0.5% of scale span.
Sensitivity: 15 microvolts or less, independent of scale span.
Power: 115 V AC, 50-60 cycles, 1 ampere.
Weight: 51 pounds
Dimensions: Overall 19" wide x 10.375" high x 15.63" deep.
Scanning Speed: 3 seconds per point (field adjustable, 1 to 10 seconds).
Control Relay Contacts: Single pole, double throw.
Control Relay Contact Ratings: 3 ampere 115 V AC, noninductive.
Ambient Temperature Limits: 60 to 105°F (15 to 40°C).
External Circuit Resistance: Potentiometer (80215) - 5000 ohms max.
Bridge (80216) - 500 ohms max.

Constant Voltage Supply Specifications

Nominal Output: 1.500 ± .1% at 1.4 ma for 115 volts input and 68°F ambient temperature. Adjustable from 1.4 to 1.6 volts.
Output Regulation: (1) Line: .001% (15 microvolts) /volt
(2) Load: .001% (15 microvolts) . 1 ma within 1.2 to 1.6 ma range
(3) Ambient Temperature: .002% (30 microvolts) /°C
Extreme Operating Conditions: Line voltage: 95 - 135 volts AC
Ambient Temperature: -20 to +80°C (-4 to +176°F)

Relay Amplifier Specifications

Sensitivity: 1 microvolt
Stability: ± 1 microvolt
Power Gain: 135 db
Voltage Gain: 4×10^7
Operating Level: 30 microvolts ± 10
AC Noise Attenuation: 135: 1 @ 60 cps
Ambient Temperature Range: 60 to 105°F

1-5 Principles of Operation

The 10 low level input signals are sequentially scanned and fed at the rate of one every 1 to 10 seconds (depending on Timer speed) to the Measuring Circuit. Here each input level is compared to its respective programmed Set Point. The Relay Amplifier amplifies the resultant error signal and produces an H (input signal higher than set point level) or L (input signal lower than set point level) contact closure. This contact closure is transferred via the Scanning Switch to the respective Process Control Relay. Another deck of the Scanning Switch illuminates the appropriate Scanning Lamp. The Process Control Relay illuminates or extinguishes the appropriate Control Lamp to show the process condition, and energizes or de-energizes the final process control element by providing an L or H contact closure. As scanning continues, the Process Control Relay maintains its contact closure until its respective process is again scanned.

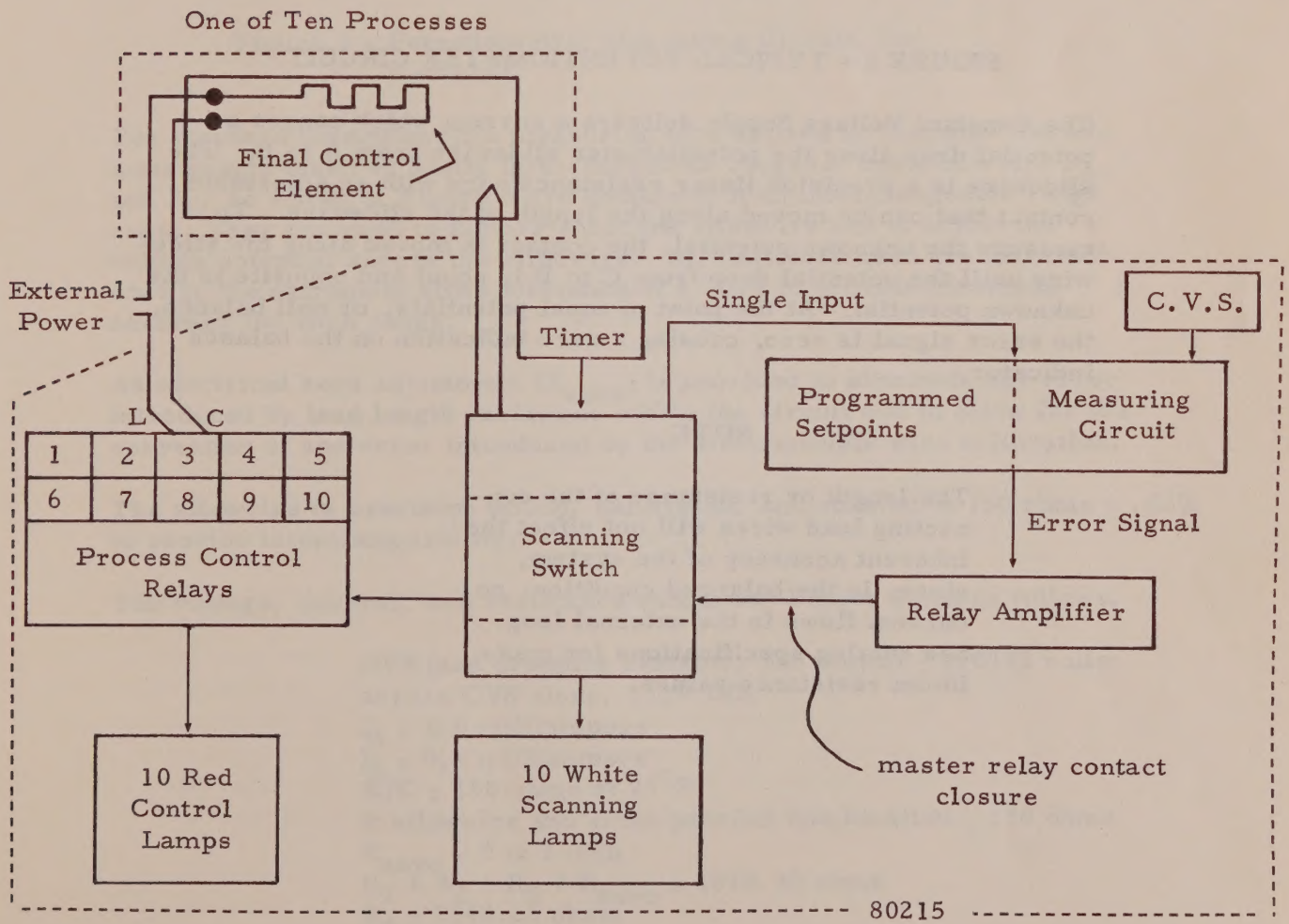


Figure 1: Block Diagram, MultiPoint Controller

Potentiometric Circuit

The potentiometer circuit is the most accurate and reliable means of determining potential and hence, thermocouple temperature. Figure 2 illustrates the operation of a typical potentiometer.

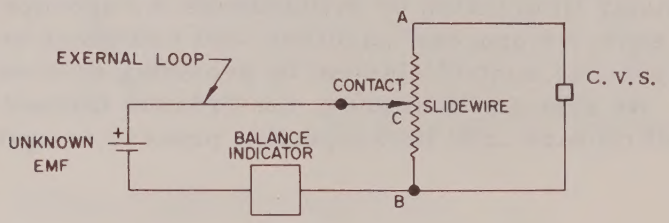


FIGURE 2 - TYPICAL POTENTIOMETER CIRCUIT

The Constant Voltage Supply delivers a current which causes a potential drop along the potentiometer slidewire from A to B. The slidewire is a precision linear resistance wire with an adjustable contact that can be moved along the length of the slidewire. To measure the unknown potential, the contact is moved along the slidewire until the potential drop from C to B is equal and opposite to the unknown potential. At the point of equal potentials, or null balance, the error signal is zero, causing a zero indication on the balance indicator.

NOTE

The length or resistance of the connecting lead wires will not effect the inherent accuracy of the system, since, in the balanced condition, no current flows in the external loop. See catalog specifications for maximum resistance values.

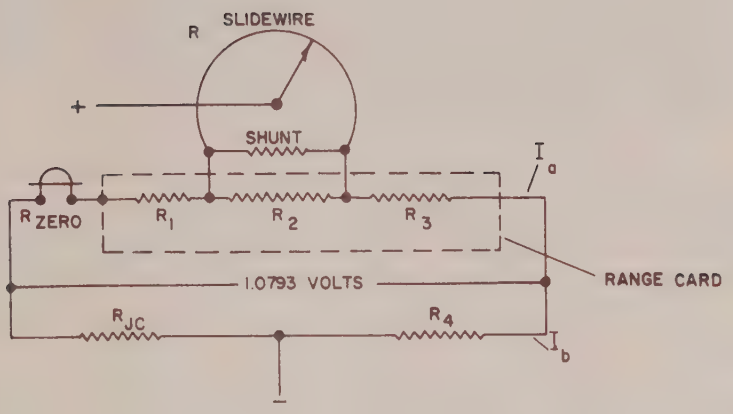


Figure 3 - Potentiometric Measuring Circuit, Resistances

The standard potentiometric measuring circuit used in Thermo-Electric instruments features easily interchangeable ranges. Resistors R_1, R_2, and R_3, as shown in Figure 3 are contained in an interchangeable range card. They are used to further shunt the slidewire and to adjust the voltage potential across the slidewire. All resistors used are manufactured to the extremely close tolerance of ± .02% to provide maximum accuracy for each range.

An electrical zero adjustment (R_{zero}) is provided to eliminate any error introduced by lead length variations within the circuit and to allow for the correction of any error introduced by the thermocouple wire calibration.

The slidewire is precision wound, calibrated, and shunted to 150 ohms ± .02% to provide interchangeability.

The voltage, current, and resistance values for Figure 3 are as follows:

CVS (and dropping resistor, not shown) = 1.0793 volts: across CVS alone, 1.5V DC.
I_a = 1.0 milliampere
I_b = 0.4 milliampere
RJC = 150 ohms at 75°F
R slidewire and shunt parallel combination = 150 ohms
R_{zero} = 0 to 1 ohm
$R_1 + R_2 + R_3 + R_{zero}$ = 1079.30 ohms
R_4 = 2548.25 ohms

Relay Amplifier

This network, as illustrated in SD-70298 comprises five major sub-circuits. Namely, the input filter, the dc to ac converter, the voltage amplifier, the phase discriminator and power amplifier, and the power supply circuits. The latter circuit is of standard variety and since its function is commonly well known no further elaboration is made on it.

For the purpose of simplicity and clarity the following operational analysis is based on instantaneous conditions with polarities as indicated in SD-70298. The error signal applied to the amplifier input is assumed to be negative, that is, the variable temperature to be monitored is below the level of the control set point temperature.

The error signal applied to pin #1 and #2 of the input plug first passes through the input filter. This circuit is a three section R-C low pass filter arrangement having a 60 cycle rejection factor of approximately 200. It is designed to eliminate or substantially reduce any a-c noise component induced in the measuring circuit (transverse interference signals). Capacitor C18, provides a low impedance path to ground for any electrostatic noise component picked up by the measuring circuit (longitudinal interference signals), thus preventing such signals from entering the amplifier.

After passing through the input filter the signal enters the conversion circuit, with the negative side applied to the (a) of the input transformer, via the chopper reed and its contact, (a). The positive side is connected to the center tap of the transformer. This will make (b) of the secondary winding of the transformer negative with respect to (a).

The signal then is passed through five stages of voltage amplification making the control grids of each stage alternately positive and negative with respect to ground. The total voltage amplification of the signal is equivalent to a gain of approximately 2×10^6 @ operating level. At the fifth stage, the grid circuit employs a diode which in effect reduces the otherwise relatively high negative grid-bias value of this stage to such a level which locates the operating point on the steepest portion of the dynamic transfer characteristic curve. Thus the maximum mu factor is obtained. In addition to the rectifier action, the diode favorably conditions the active half cycle of the operating signal inasmuch as it reduces substantially any external as well as internal noise component during this half period.

After voltage amplification the signal is applied to the grid of the phase discriminating and power stage. Under the assumed operating conditions and polarities as indicated, the power section of V3 will conduct during each active half cycle; thus a pulsating d-c component, smoothed by a capacitor C17, is flowing through the master relay coil which in turn actuates its armature. The active half cycle, being less negative with respect to ground or positive with respect to its preceding inactive half cycle of reference voltage on the plate, during which time of course the tube will conduct.

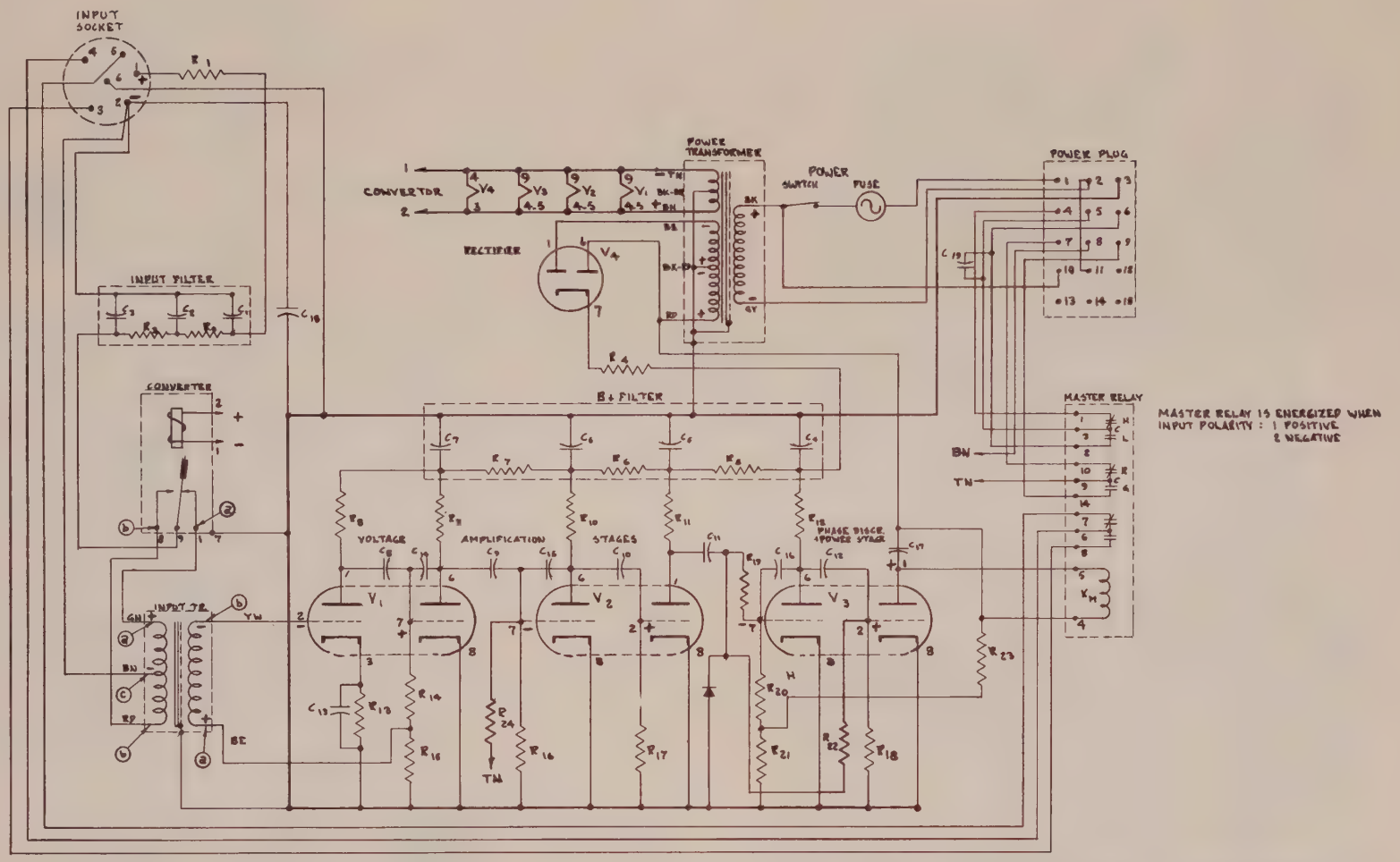
With the master relay coil energized, the output to the control circuit will consist of a C-L contact closure.

When the error signal polarity is reversed, as is the case when the temperature to be controlled exceeds the level of the control set point temperature, phase discrimination in the output stage will not permit current flow through the relay circuit during either half cycle, since during the positive half cycle of the plate, the signal swings negative, preventing the tube from conducting. Thus the master relay is de-energized and its output to the control circuit will consist of a C-H contact closure.

One more set of SPDT contacts is being operated in series with the 6V heater supply of the amplifier to energize the green and red control indicator lights alternately when the relay is energized or de-energized.

To enhance stability and non-critical interchangeability of tube components, the unit employs negative feedback from the second to the first stage. Hash filter capacitors are used in the second, third, and fifth stages, which permits non-critical wire dressing without causing HF oscillations.

The amplifier has a fail-safe device which in effect will cause the master relay to be de-energized in case of either open input circuit, amplifier components breakdown, or power failure.



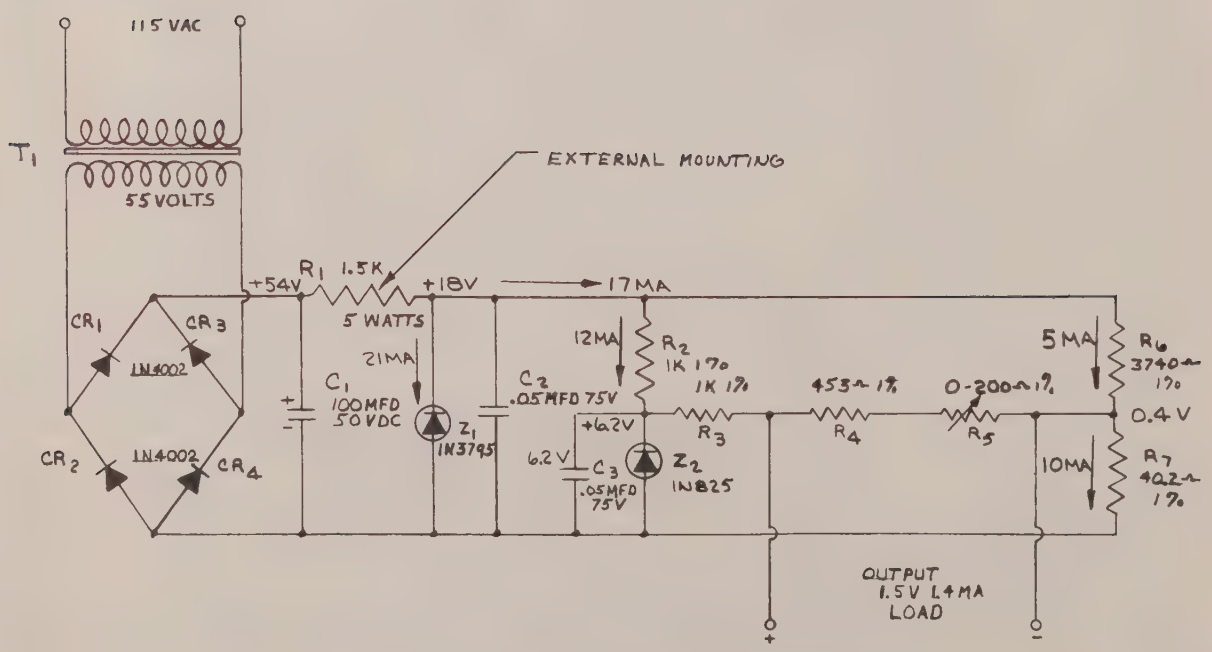
	THERMO ELECTRIC CO., INC. SADDLE BROOK NEW JERSEY	AMPLIFIER RELAY CONTROL SCHEMATIC DIAGRAM	
		DW'N. BY DH	DATE 1-26-69
		CHK. DR. CB	ENGR.
			PROJ. ENGR.
			SD 70298

Eugene Dietzgen Co., Inc., New York, N.Y. No. 1883M Aggproof Tracing Vellum

Constant Voltage Supply

The Constant Voltage Supply provides a constant 1.5 volt DC voltage to a constant load (controller measuring circuit) regardless of voltage fluctuations in the incoming AC line.

AC line voltage is applied to the stepdown transformer and rectified by the full wave diode bridge circuit. Capacitor C_1 and the resistance of the transformer's secondary combine to provide 60 cycle filtering. Regulation is accomplished in two stages. The first stage consists of the zener diode Z_1 and R_1 (current limiting resistor). Filter capacitors C_2 and C_3 suppress noise in diodes Z_1 and Z_2. The second stage regulation is accomplished by zener diode Z_2. The Wheatstone bridge circuit (R_2, R_6, R_7, Z_2) effectively cancels the internal zener impedance effect to provide optimum regulation. The dividing network (R_3, R_4, R_5) provides the required 1.4 MA output across the constant external load. Resistor R_5 is externally adjustable and provides the means for adjusting the output to the specified accuracy.



2-0 INSTALLATION

2-1 Unpacking

Leave the instrument in the packing box until ready to install it. In general, instruments are shipped with small accessory items in the same box. Check all items against the packing list before discarding the shipping container and packing material.

2-2 Location

Locate the controller in an area free from excessive vibration and away from strong electrical or magnetic fields, such as produced by large power transformers and motors. For best results locate the instrument in a room with a dry, clean atmosphere which is free from sudden drafts or wide variations in ambient temperatures.

2-3 Mounting

Remove the cable connectors at the rear of the controller and loosen the four quick-fasteners on the front panel. Remove the instrument from the case by pulling the panel mounted handles outward and up. Mount the case in the panel and replace the instrument.

See dimensioned mounting drawing in the Appendix of this manual. Hardware is included for mounting the instrument in a relay rack or cabinet, wooden panel cut-out or heavy gage metal panel cut-out.

2-4 Electrical Connections

Power Input: The power input requirement of the instrument is 115V, 60 cycle AC, 1 ampere. The voltage should be maintained ± 10 volts. The power input terminal strip is in the rear compartment of the instrument (remove the compartment cover by removing the four retaining screws in each corner). The location of the power strip is noted in the rear view photograph in the Appendix of this manual. Remember to replace the protective fiber cover over the power terminals when wiring is completed. Do not install power cables in the same conduit with thermocouple leads.

Grounding: Ground the instrument (right hand terminal on the power input terminal strip) according to NEMA standards or other acceptable methods. Conduit grounds must often be avoided, as their potential with respect to a water pipe ground is often high enough to prove detrimental to the performance of the instrument.

Control Wiring: The process control terminals are just above the power terminal strip (see Appendix). For each of the ten thermocouple inputs and their corresponding set points, there is a set of three control terminals. When a process temperature is below its set point level on the controller, the C and L terminals are connected.

When the process temperature rises above the set point, the C and H terminals are connected, and the C and L terminals open.

Since the controller supplies contact closures only, an external power source must be used to energize the final control element (heater element, etc.). If desired, power may be jumpered from a power input terminal to the control terminals to energize the final control element; however, be careful that the other side of the power line is the one connected to the remaining side of the final control element. A diagram is included in the appendix of this manual illustrating 10 typical installations. If the final control element draws more than 3 amps at 115 V AC, an intermediate control member (load relay, contactor, etc.) must be used between the instrument control terminals and the process.

Thermocouples: The thermocouple input terminals are to the right of the control terminals. The thermocouple input numbering corresponds to the set point and control terminal numbering. Observe polarity when connecting thermocouple or thermocouple extension wires to the input terminals, (negative leads are red, or when a red lead is not present, yellow is negative).

3-0 OPERATING INSTRUCTIONS

3-1 Operating Controls

The 10 Set Point Knobs on the front panel are used to individually adjust the position of each set point pointer on the horizontal calibrated scales. It is not necessary to stop scanning when adjusting set points.

The Automatic-Manual switch has two positions. In the "up" or Automatic position the controller advances from point to point automatically. In the "down" or Manual position automatic scanning is stopped.

The Advance button will advance the controller scanning one position each time it is operated. This procedure is performed with the Automatic-Manual switch in the Manual position.

The On-Power switch is used to energize the instrument prior to operation. The amber Power-On lamp illuminates when the instrument is energized.

The locations of these operating controls are illustrated in Figure 1 in the Appendix of this manual.

3-2 Operating Procedures

The instrument is shipped with all parts in place ready for operation. Remove any internal packing material. After mounting and making all electrical connections, as instructed in Section 2, the instrument is ready for operation. Proceed as follows:

A. By means of the proper numbered set point knobs, adjust the pointers to the desired temperatures on the set point scales for each temperature to be controlled.

B. Check to see that the amplifier toggle switch is in the "on" position. Move power switch to the on position and Automatic-Manual switch to automatic position. The controller will then start to scan the temperatures and the scanning lights will glow in sequence.

C. In the event of an over-temperature condition on any of the points, the corresponding red control lamp will light when scanned, and stay lighted and the process control relay will shut off the power to the process. When process temperature drops below the setpoint, the process control relay will energize and turn on the power again, and the red control lamp will be extinguished.

To Change the Scanning Speed

The cycle adjust resistor located on the timer terminal strip (shown in the Appendix) can be replaced with a resistor of a different value in order to change the speed of scanning. Table 1 shows the approximate value resistor to use for scanning speeds of from 1 to 10 seconds.

SCANNING SPEED (seconds)	TIMER RESISTOR (ohms)	
1	5.6K	1 watt
2	10K	1 watt
3	18K	1/2 watt
4	25K	1/2 watt
5	37K	1/2 watt
6	55K	1/2 watt
7	82K	1/2 watt
8	136K	1/2 watt
9	300K	1/2 watt
10	Remove Resistor	

TABLE 1

To Change the Range

To change the range of the instrument, it is necessary to change the range card and the calibrated scales. Also, it is recommended that the calibration be checked. Without recalibration after the range

change, instrument accuracy may not remain in the .5% standard limit. The reference junction compensating resistor is not changed unless the change in range also involves a change in the type of calibration; for example, Iron-Constantan to Chromel-Alumel, or Iron-Constantan to a millivolt range. Refer to the table of ranges in the Appendix.

NOTE

If the range change is, for example, from 0-10 millivolts to 0-100 millivolts, a "X 10" multiplier may be displayed on the calibrated scales rather than changing them. Multipliers should not be used with non-linear scales (this includes all temperature scales).

Proceed as Follows:

A. Remove the controller from its case.
B. Remove range card, two flat head screws holding measuring circuit board, and slidewire cover.
C. Remove set point knobs (#4 Allen wrench) and retaining rings and nuts from set point shafts.
D. Place cloth padding over amplifier, and remove slidewire panel, placing scales topside on amplifier. Use extreme care when handling slidewires to avoid scratching and denting them.
E. Remove the two retaining screws holding each scale in place. Next, slide a sharp knife under each scale to break the adhesive seal.
F. Install new scales. To prevent possible buckling, new scales may be glued down. Weldwood contact cement will do the job nicely.
G. Reinstall slidewire panel, zero adjust board, and install new range card. Replace compensating resistor if necessary.
H. Check instrument calibration and adjust if necessary.
I. Replace slidewire cover.

4-0 PERIODIC MAINTENANCE

4-1 General

Carried out according to the schedules set forth below, the following component preventitive maintenance procedures will decrease the possibility of instrument failure at a critical time, and extend the life span of the controller.

4-2 Maintenance Schedules

Scanning and Alarm Lights

Turn automatic manual switch to manual. Check each scanning light by manually advancing from point to point. Stop on each point and

check the alarm light by lowering the set point until it is lower than the temperature being controlled. This will cause the red control light to glow. To replace a burned out lamp, unscrew the lens cap and replace the lamp with a new one of the same type (G. E. #47 or equivalent). Perform once per week, minimum.

Amplifier

The tubes and chopper in the amplifier can be expected to provide more than one year of continuous service. Rather than check the tubes at monthly or bi-monthly intervals at the cost of shutting down the equipment, it may be more desirable to substitute a complete set of spare tubes, relay and chopper at six month intervals, and to check the removed components more thoroughly at an instrument shop. To remove a tube, turn tube shield 1/4 turn counter-clockwise and pull out. Remove tube with a straight upward pull. Please Note: When replacement of tubes is necessary, make sure the new tubes meet manufacturers' specifications.

Stepping Switch

The stepping switch should be lubricated at the regular intervals recommended in the table:

Stepping Switch Lubrication Schedule				Switch
Operating Speed	First Service	Second Service	Reg. Maintenance	Life
6.0 sec/pt	3 months	6 months	6 months	50 yrs.
3.0 sec/pt	6 weeks	6 months	6 months	24 yrs.
1.0 sec/pt	2 weeks	10 weeks	5 months	8 yrs.

Lubrication points and recommended lubricants are shown on drawing S 133 in the Appendix.

The stepping switch mechanism may be exposed by first removing the two screws from the top of the cover and then removing the cover with a straight upward pull. It may also be entirely removed for servicing. Before removing the cover, loosen the two retaining screws under the controller chassis and remove the switch with a straight upward pull on the cover.

Relays

The ten point controller contains 10 process control relays and one master relay (see Appendix for locations). These relays should be inspected at 6 month intervals for carbon build-up and pitting. Carbon should be removed with a stiff brush. It is usually advisable to replace a relay once pitting has occurred, although burnishing with a tool designed especially for the purpose will serve as a temporary repair. If control relays fail frequently the load current and voltage should be

checked for conformance to the relay contact rating (115 V AC, 3 AMP, noninductive).

Pulse Timer

The following maintenance procedures should be completed at the intervals prescribed in the table below:

SCANNING SPEED	NUMBER OF OPERATIONS PER MONTH	CHECK TIMER EVERY
1 sec/point	2,592,000	2 months
2 sec/point	1,266,000	4 months
3 sec/point	633,000	6 months
4 sec/point or more		6 months

Remove the cover from the pulse timer. Inspect the contacts on the K_2 "wired in" relay. If necessary, clean the contacts with a fine contact cleaning tool.

Remove the K_1 "plug in" relay and its plastic cover. Repeat procedure noted above. If carbon or metallic partical accumulation has occurred on the tops of the wafers between the contact arms, remove with the edge of a burnishing tool or with a stiff wire brush.

Should a relay show signs of heavy contact pitting, it should be replaced.

NOTE: Replacement of the K_1 relay may slightly affect the timing functions. The time cycle may be corrected by changing the value of the cycle adjust resistor. If the remaining timing functions are required to remain within the original accuracy, it is recommended that the pulse timer be returned to Thermo-Electric for recalibration.

5-0 TROUBLE SHOOTING

5-1 General

Before attempting trouble shooting procedures, check to see:

(1) If fuses are in good condition.
(2) If proper components are used in their proper positions.
(3) If indicator lamps are in operating condition.
(4) If "grounded type" thermocouples are properly grounded.
(5) If external load relays, contactors, etc. function properly.
(6) If the instrument is grounded properly.
(7) If all connectors and plugs are properly attached, and all connections properly made.

5-2 Trouble Shooting Guide

Symptom of Trouble	Possible Cause
Instrument does not function Lights do not illuminate	1. AC fuse blown
"Power ON" and "Scan" lamps function but all points remain in fail-safe (all red lamps remain illuminated) - process not activated	1. DC fuse blown 2. Amplifier fuse blown or switch off 3. Amplifier component faulty
One of the 10 controlled processes over heats or will not heat	1. Process Control relay or external load relay faulty. 2. Defective input transducer, extension lead or connection
Instrument will not scan automatically or scanning is erratic	1. Defective timer
Instrument will not scan automatically or manually	1. Defective stepping switch, stepping switch power supply or stepping switch fuse
Scanning lamp illumination or control is erratic	1. Stepping switch wipers loose and not aligned properly
Erratic control on one or several points	1. Grounded type thermocouple not grounded properly 2. Thermocouple sensing element shorting from moisture condensation, heat warpage, etc.
Erratic control on all points	1. Instrument located too close to a strong electrical or magnetic field source. 2. Defective chopper in amplifier 3. Instrument not grounded properly. 4. Intermittent ground in measuring circuit.

Calibration Off:	1. Zero adjust not adjusted properly. 2. Constant voltage supply out of adjustment 3. See "CALIBRATION", section 6.
Calibration Drifts	1. Incorrect or defective compensating resistor 2. Constant voltage supply defective 3. Faulty range card resistor

See the Appendix for component locations and amplifier component values. General instrument specifications and measuring circuit values are given in Section 1.

Quantity Used In Instrument	Stock*	T-E Part Number	Description
1		70298	Amplifier (Complete)
2	2	7220	tube, 12AX7 (Amplifier)
1	1	7221	tube, 12AU7 (Amplifier)
1	1	7222	tube, 6X4 (Amplifier)
1	1	7865-2	chopper (Amplifier)
1	box of 5	7245-1	fuse, 1 amp (Amplifier)
1	1	7893	master relay (Amplifier)
1		7866	power transformer (Amplifier)
1		80324	Constant Voltage Supply
5		A1570	Translatory Slidewire Ass'y. (Complete)
5		70217	slidewire winding (Slidewire Ass'y.)
10		A1864	slidewire contact (Slidewire Ass'y.)
5		**	Calibrated Scale
1	box of 5	7245-7	Fuse, AC, 1 amp, Slow Blow
1	box of 5	7245-2	Fuse, DC, 1/2 amp
1		7140	Fuse Post
10	2	A1779	Process Control Relay
1		7922	Transformer Process Control Relay
2		A2258	Rectifier (Power Supply)
1		A1590	Stepping Switch (plugs in)
1		A4071-3	coil (Stepping Switch)
1	1	A2379	Stepping Switch Lubrication Kit
1		A3951	Stepping Switch Power Supply
1		A4178-2	Stepping Switch Fuse
1		70325	Timer (Complete)
1		A1477	plug-in relay, K1 (Timer)
1		A1478	relay, K2 (Timer)
1		7909	Manual Pushbutton Switch
1		A1585	Power Switch, toggle, DPDT
21	box of 10	7244	Lamps, G. E. #47
10		7037-5	Lens Cap, White
10		7037-1	Lens Cap, Red
1		7037-6	Lens Cap, Yellow
1		A1599	Window
1		A1616	Terminal Housing Ass'y. ***(complete with Cables)
1		A1620	thermocouple cable ass'y.
1		A1621	power input cable ass'y.

* These spare parts are recommended to be kept in stock by the instrument purchaser to facilitate fast replacement.

** See Range Sheet in the Appendix of this manual. Scales, range cards and reference junction compensating resistors are ordered by specifying name of part required and instrument range and calibration.

*** A terminal housing assembly may be used for making connections to instruments on the test bench without removing the instrument case for calibration and testing.

6-0 CALIBRATION

6-1 Adjustments

Constant Voltage Supply: The Millivolt span across the slidewires may be adjusted by passing a thin screwdriver through the small holes in the right side of the controller and Constant Voltage Supply case and turning the trim pot adjusting screw therein.

Zero Adjust: The levels of the voltages across the slidewires may be adjusted by rotating the Zero Adjust Knob adjacent to the range card on the measuring circuit board.

Slidewires: To make linear calibration adjustments to an individual slidewire, the slidewire must be repositioned. Loosen the two screws at the ends of the slidewire assembly, reposition the slidewire, and re-tighten the screws.

Individual Set Points: If a calibration error occurs on one set point, but not on the second setpoint on a given slidewire, the slidewire contact must be adjusted. Proceed by grasping the slidewire contact with a pair of needle nose pliers and bend the contact slightly until readings are correct.

6-2 Method

Input Requirements: For thermocouple type instruments having a scale calibrated in degrees F (or C), calibrate using one of the three following suggested methods:

(a) Remove the reference junction compensating spool and replace with a 150 ohm wire wound manganin resistor. (Thermo-Electric Part No. 7980-6). Use a calibrated millivolt source to apply input. Connections are made with copper wire. A 75°F reference table is used for converting the millivolt input to degrees Fahrenheit (or Centigrade). Such a table is included in the Thermo-Electric Catalog.

(b) A Thermo-Electric 80200 series MiniMite may be used without installing a manganin spool in the instrument or using a reference table, as described in the MiniMite Instruction Manual.

(c) A calibrated millivolt source coupled to an ice bath may also be used for calibration without replacing the compensating spool. A 32°F reference table is required to convert the millivolt input signal to degrees. A copper lead is run from the MV source's "+" terminal to an ice bath. Here, submerged, it is joined to a "+" lead of thermocouple material wire, which in turn is connected to the "+" input terminal of the instrument to be calibrated. A second copper lead is run from the MV source's "negative" terminal to the ice bath, where it is joined with the "negative" material wire, the opposite end of which is connected to the instrument's "negative" terminal.

To speed calibration checks on the Multi-Point controller, the ten input terminals may be connected in parallel with copper or thermocouple material wire until calibration is completed.

Calibration Procedure

(1) Place the Automatic-Manual switch in Manual position and use the Advance button to advance the scanning switch to each point to be checked.

(2) Check points 6 through 10 at a low temperature reading on the scale (Approximately 5% of full scale) and note error.

(3) Correct error perceived on points 6 through 10 by adjusting the zero adjust.

(4) Error applying to individual points may be corrected by adjusting the Slidewire for that point.

(5) Check points 1 through 5 at 5% of full scale. Correct any error by adjusting the Individual Set Point. Slidewire contacts are factory set and should be adjusted only when absolutely necessary.

(6) Check points 1 through 10 at a high temperature reading (approximately 95% of full scale). If the preceeding steps were completed properly, any error read now should be equal for all points and can be corrected by adjusting the Constant Voltage Supply trim pot.

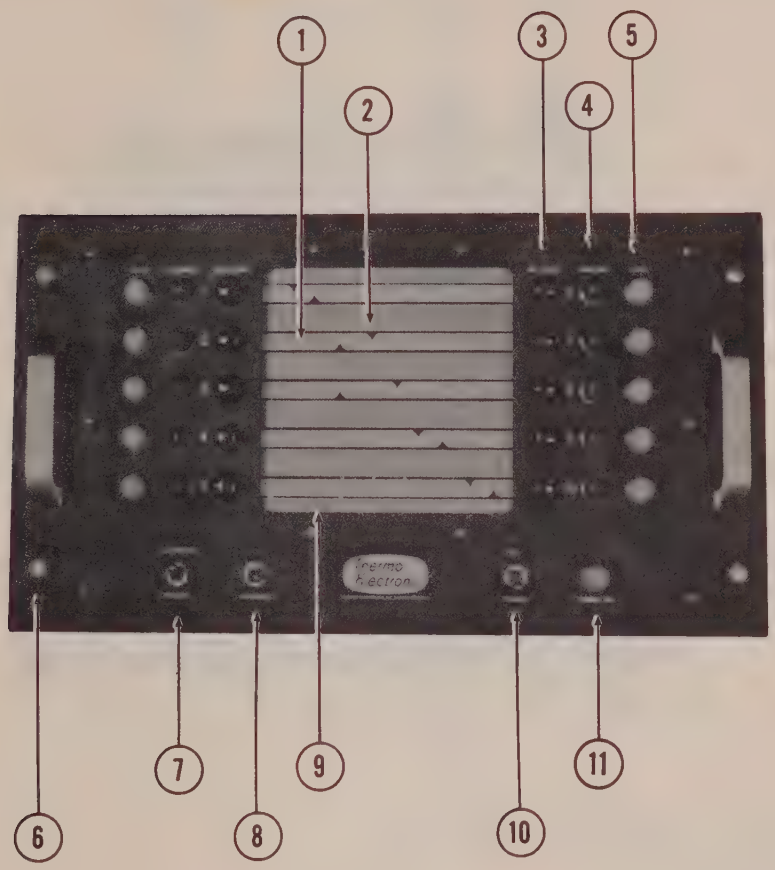
(7) Check points 1 through 10 at center scale. If error is noted here, it must be split over the rest of the scale as follows:

(a) For similar error at all 10 points adjust the Zero Adjust.
(b) For error equal on two points utilizing the same slidewire (e.g., Points 2 and 7) the Slidewire should be adjusted.
(c) For error on one point only, adjust the Individual Set Point.

(8) Recheck all 10 points at 5%, 50% and 95% of full scale.

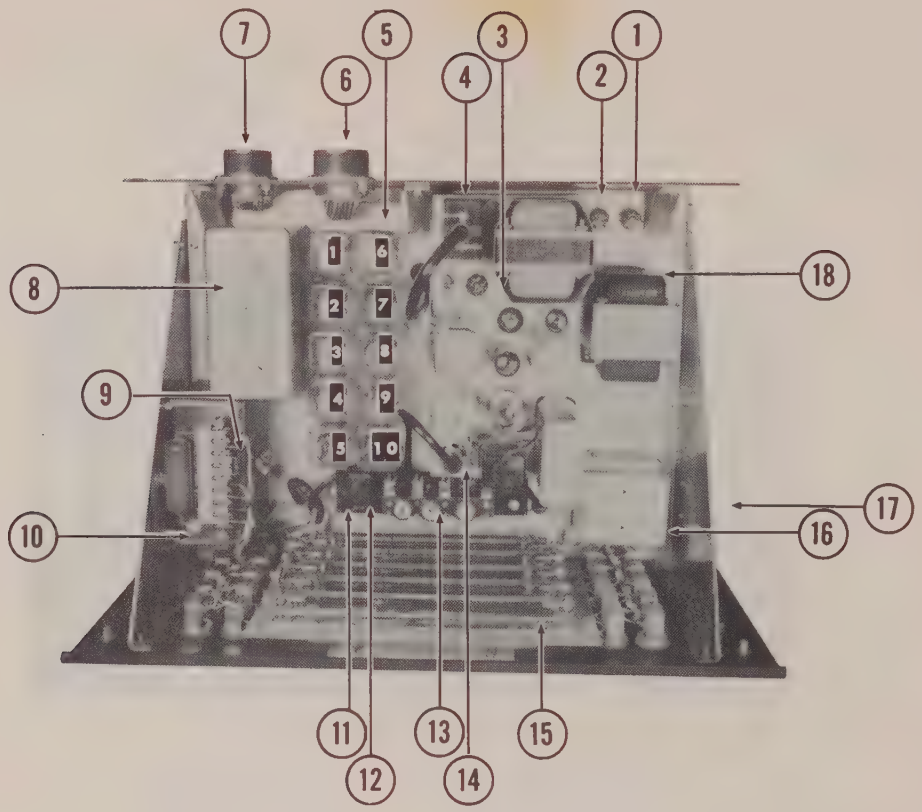
7-0 APPENDIX

MULTI-POINT CONTROLLER FRONT VIEW PARTS IDENTIFICATION



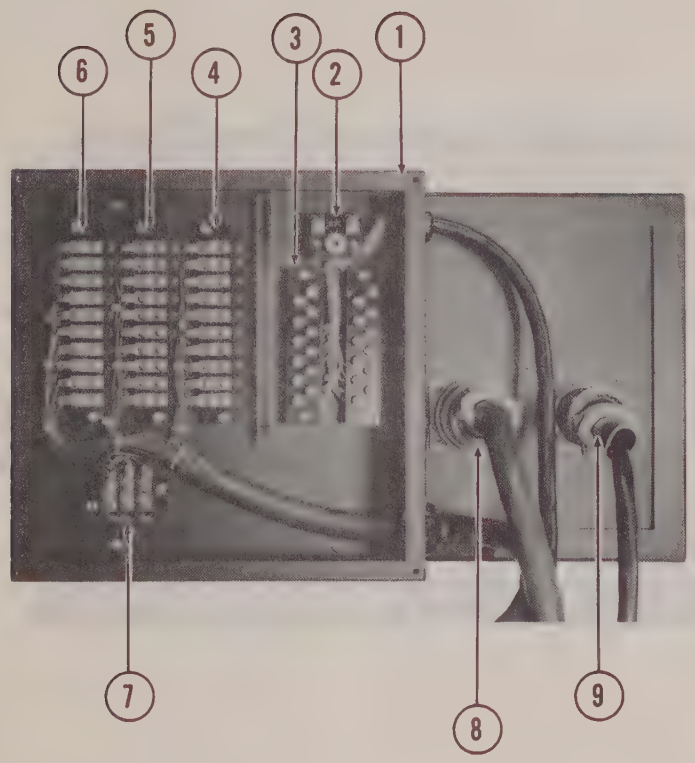
1. Calibrated Scales
2. Set Point
3. Set Point Adjust Knobs
4. Red Control Lamps (L_{11} to L_{20})
5. White Scanning Lamps (L_1 to L_{10})
6. Quick-fasteners (4), loosen to remove instrument from case.
7. Scanning on-off Switch
8. Manual Advance Pushbutton
9. Window
10. Power on-off Switch
11. Yellow power-on lamp (LP)

MULTI-POINT CONTROLLER TOP VIEW PARTS IDENTIFICATION

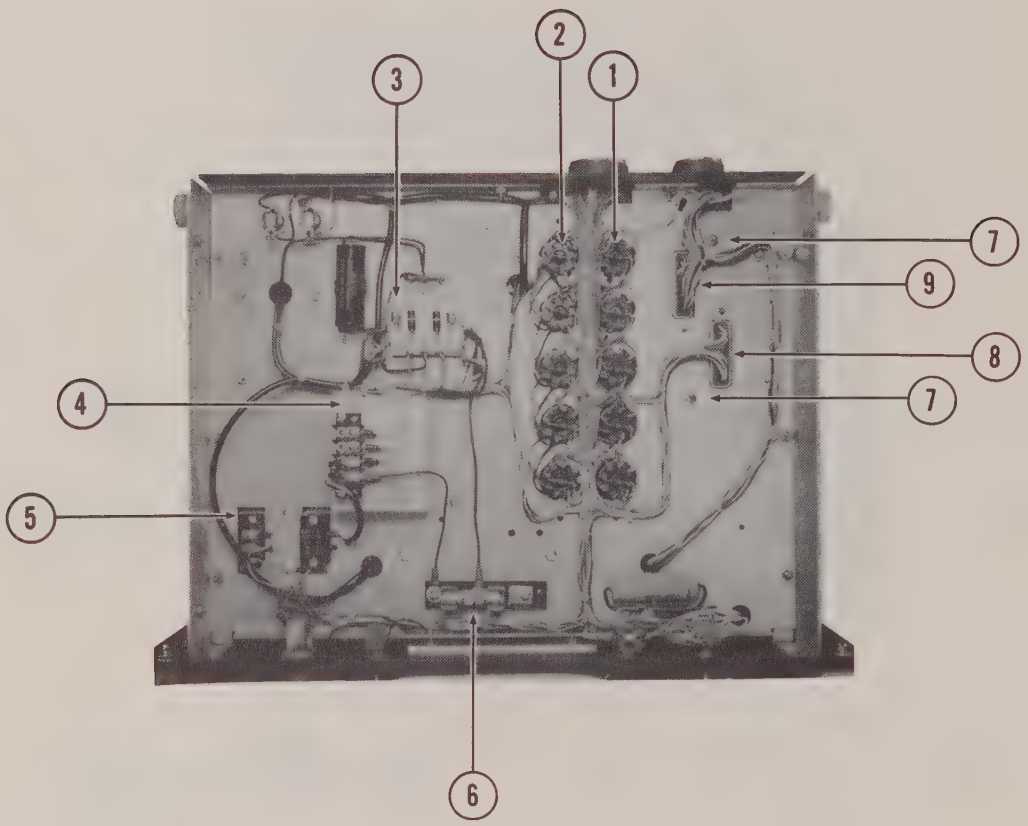


1. AC fuse (1 amp slow blow)
2. DC fuse (1/2 amp)
3. Amplifier
4. Amplifier power plug
5. 10 process control relays (numbers in photo agree with set point identification numbers)
6. CP_4 (Power input)
7. CP_3 (thermocouple input)
8. Scanning Switch Cover (removable)
9. Timer cycle adjust resistor
10. Pulse Timer
11. Measuring Circuit Board
12. Zero Adjust
13. Range Card Resistor s
14. Amplifier Input Plug
15. Slidewires
16. Constant Voltage Supply
17. C.V.S. Adjustment
18. Transformer (process control relay power supply)

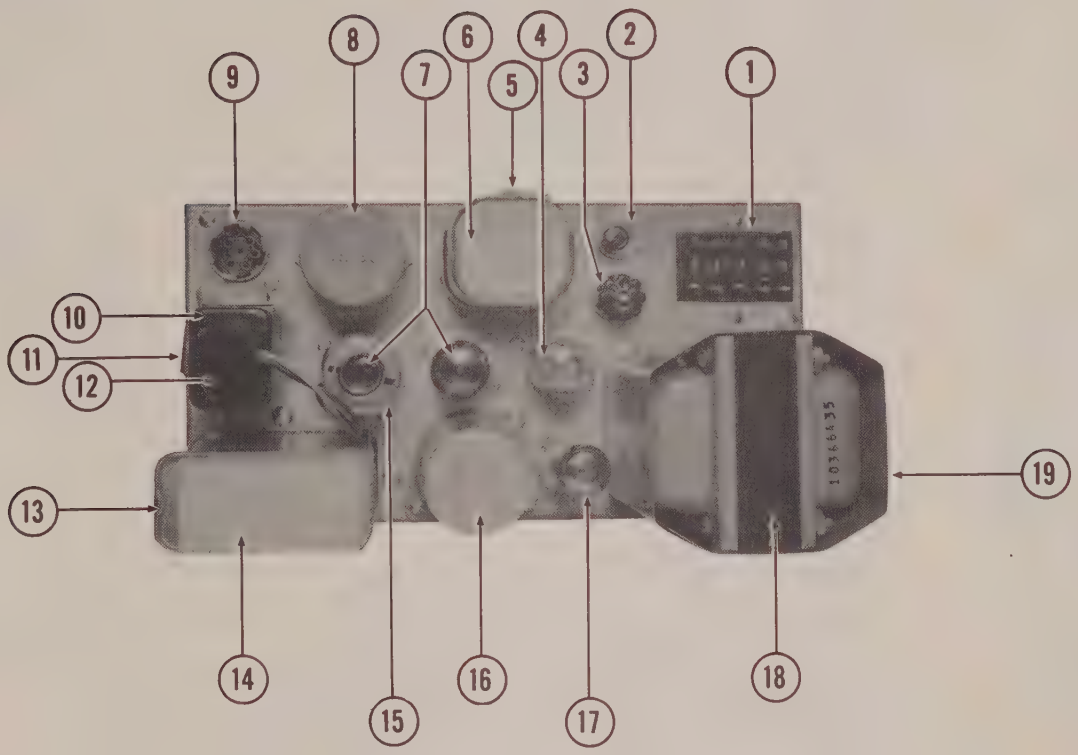
MULTI-POINT CONTROLLER REAR VIEW PARTS IDENTIFICATION



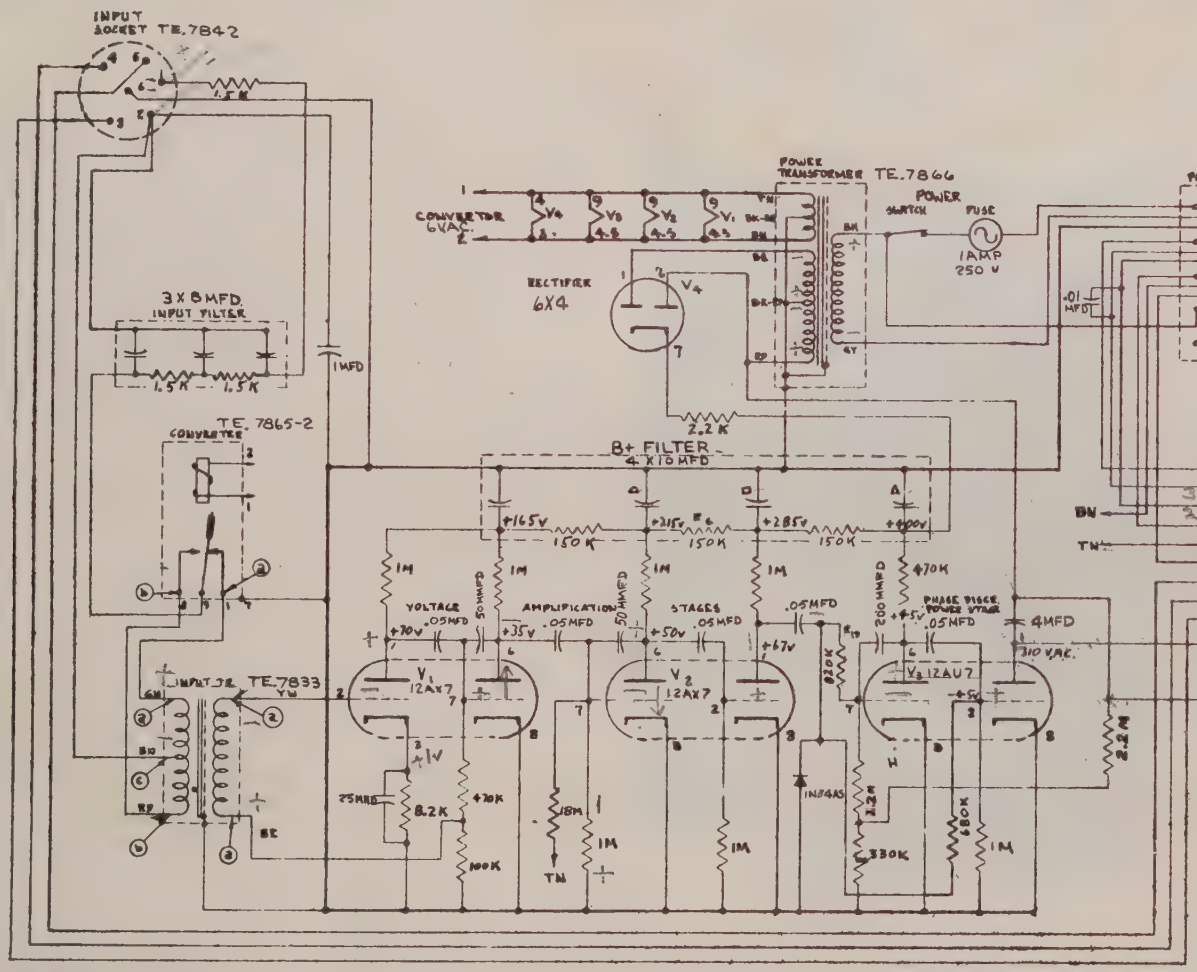
1. Rear compartment (Terminal housing ass'y., includes cables and connectors).
2. Reference junction compensating resistor (R.J.C.)
3. Thermocouple input terminals.
4. L (low) process control terminals.
5. C (common) process control terminals.
6. H (high) process control terminals.
7. Power input terminal strip.
8. Power input cable ass'y.
9. Thermocouple cable ass'y.



1. Process control relay (K_1 to K_5) sockets
2. Process control relay (K_6 to K_{10}) sockets
3. Rectifiers (process control relay power supply)
4. Stepping switch power supply
5. Constant voltage supply
6. Stepping switch power supply fuse
7. Stepping switch retaining screws
8. CP_2
9. CP_1



1. Power Plug
2. Power Switch 125V 6A
3. Fuse 1A 250V 1 amp 250V
4. Tube 12AU7 V3
5. Relay Clamp
6. Control Relay
7. Tube 12AX7 V1, V2
8. Input Transformer
9. Input Socket
10. Chopper (converter)
11. Clamp-Chopper
12. Chopper Connector
13. Input Filter Capacitor
14. Tube Location Label
15. Tube Shield
16. B+ Filter Capacitor
17. Tube 6X4 V4
18. Power Transformer
19. Magnetic Shield

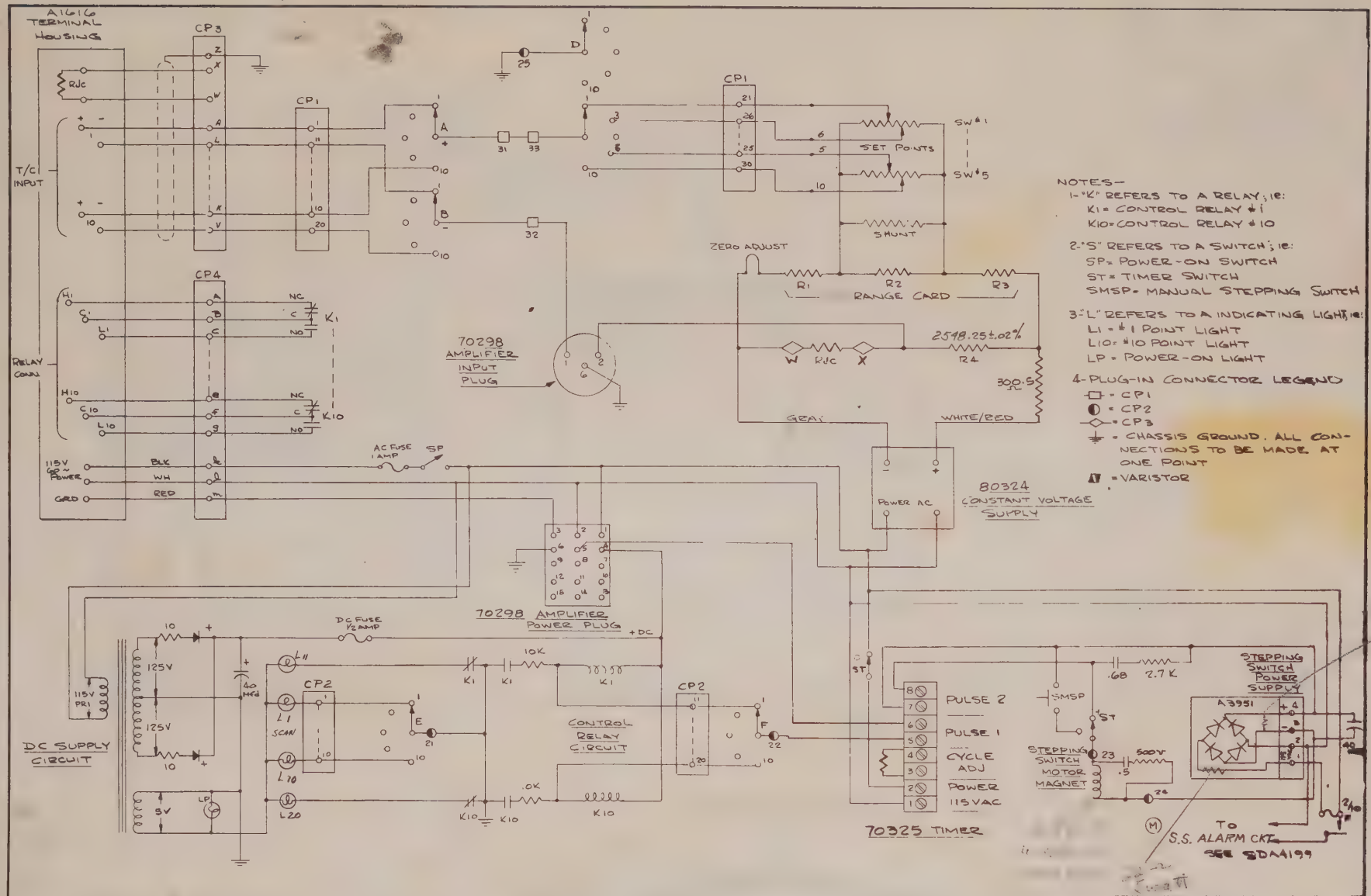


1. ALL VOLTAGE READINGS TAKEN WITH A 20K Ω/VOLT V.O.M.
2. READINGS MADE WITH ZERO INPUT (SHORTED)
3. AMPLIFIER SENSITIVITY 1MV, LEVEL 30 MV ±10

THERMO ELECTRON.. INC.

AMPLIFIER RELAY CONTROL SCHEMATIC DIAGRAM FOR CHECKING OPERATION

IRZ | 10-29-64 | CS-70298



NOTES—

1-"K" REFERS TO A RELAY; IE:
K1 = CONTROL RELAY #1
K10 = CONTROL RELAY #10

2-"S" REFERS TO A SWITCH; IE:
SP = POWER-ON SWITCH
ST = TIMER SWITCH
SMSP = MANUAL STEPPING SWITCH

3-"L" REFERS TO A INDICATING LIGHT; IE:
L1 = #1 POINT LIGHT
L10 = #10 POINT LIGHT
LP = POWER-ON LIGHT

4-PLUG-IN CONNECTOR LEGEND
□ = CP1
◐ = CP2
◇ = CP3
⏚ = CHASSIS GROUND. ALL CONNECTIONS TO BE MADE AT ONE POINT
▽ = VARISTOR

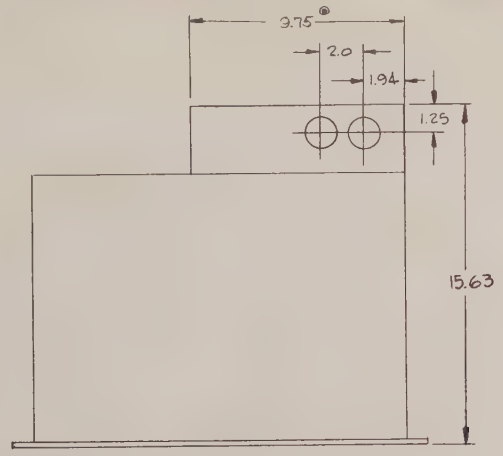
(P) FOR 2 POSITION CONTROL WITH ADJUSTABLE NEUTRAL ZONE SEE A2966

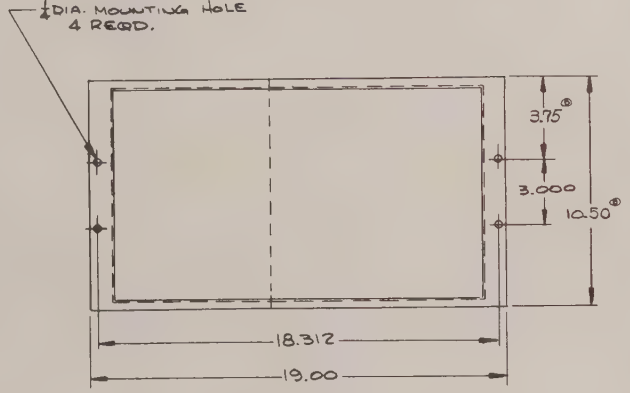
FOR 3 POSITION CONTROL SEE A4149

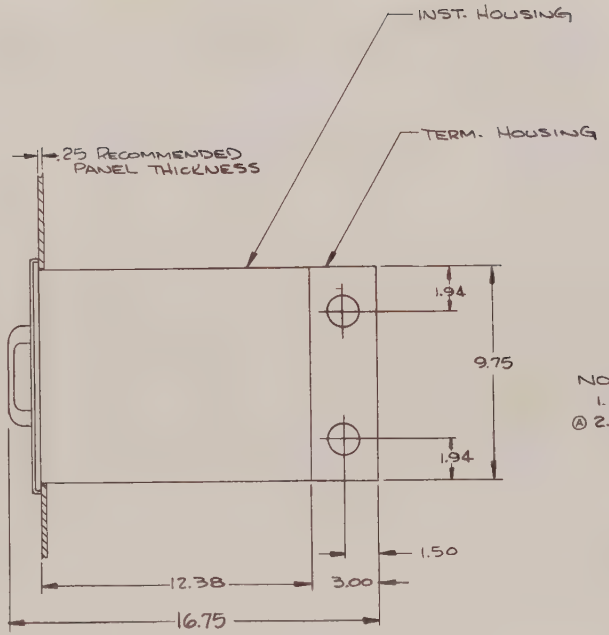
THERMO ELECTRIC CO., INC.
SADDLE BROOK, N. J.

SCHEMATIC DIAGRAM
MULTI-POINT CONTROLLER

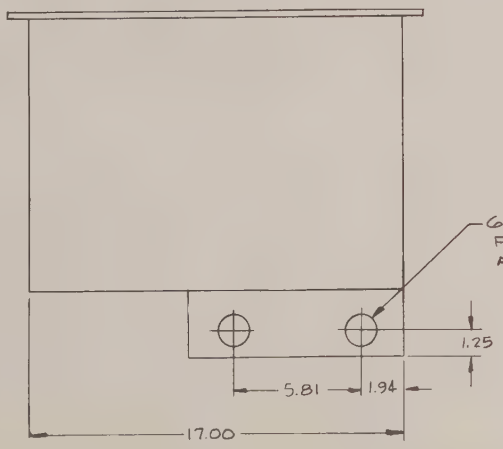
DRAWN BY	DATE	SD
	1-29-59	80215
CHECKED BY	ENG.	





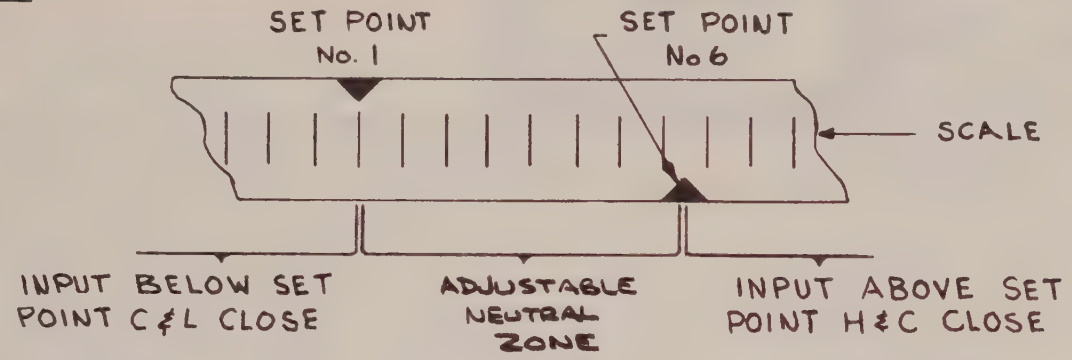


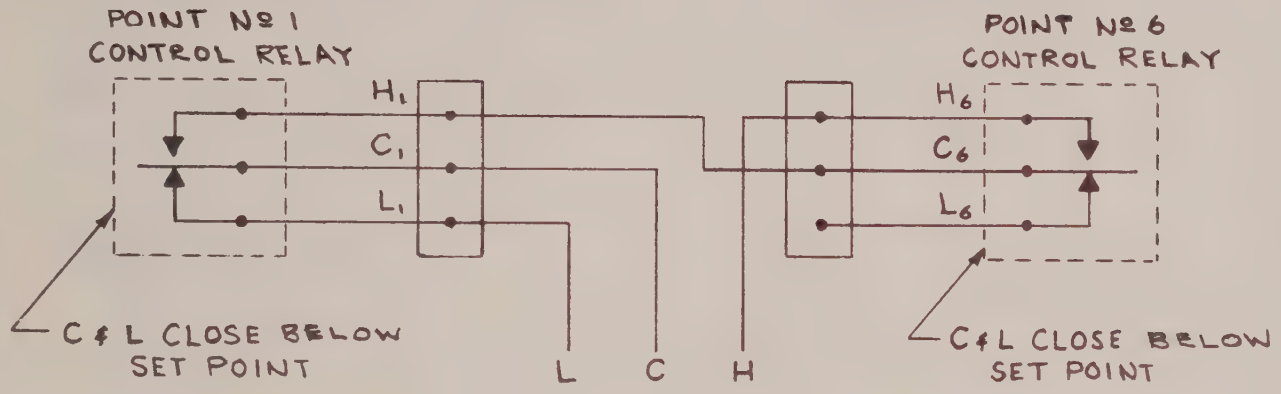
SIDE VIEW SHOWING
FRONT PANEL & HANDLES



NOTES:-
1. ALL DIMENSIONS ARE NOMINAL
Ⓐ 2. RECOMMENDED PANEL CUTOUT IS
17.13 WIDE x 9.88 HIGH

THERMO ELECTRIC CO., INC. SADDLE BROOK, N. J.		
INSTALLATION DIM'S. FOR MODEL Nº 80215 MULTI-POINT CONTROLLER.		
DRAWN BY	DATE 12-20-61	ID 80215
CHECKED BY	ENG. RB	





NOTES
1.- FAILSAFE OR T/C BURNOUT C & H CLOSE
2.- INPUTS 1 & 6, 2 & 7 ETC. ARE COMMON

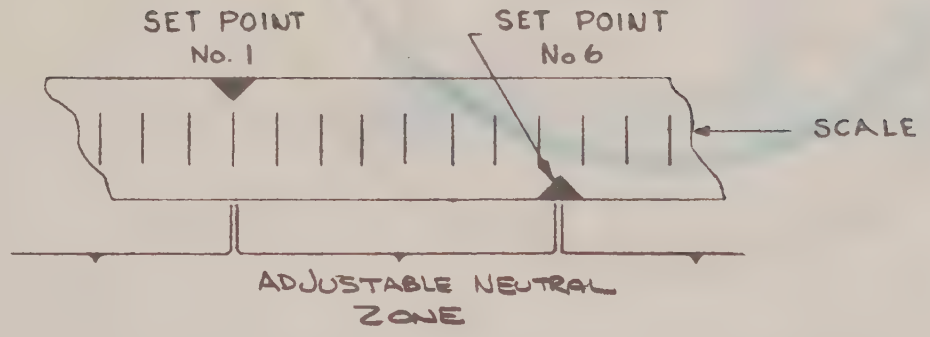
MODEL 80215

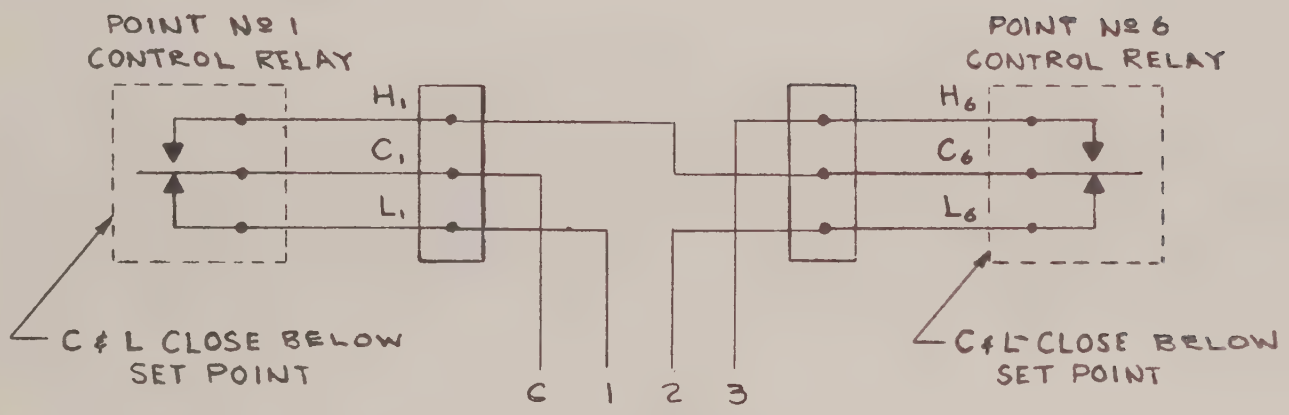
Thermo Electric

2 POSITION CONTROL WITH ADJUSTABLE NEUTRAL

DWN. WAL	DATE 10.9.62	A 2966
CKR.	ENGR.	
CHF. DR.	PROJ. ENGR. RB	

RO-AD 105





NOTE:
1.- INPUTS 1&6, 2&7
ETC. ARE COMMON

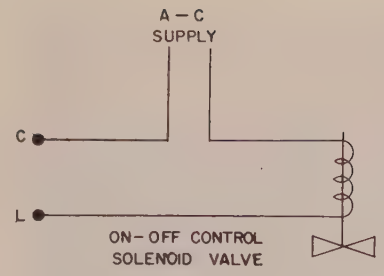
MODEL 80215

Thermo Electric

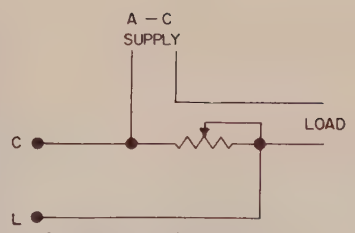
3 POSITION CONTROL SCHEMATIC

DWN.		DATE 1-7-65	A4149
CKR.		ENGR.	
CHF. DR.		PROJ. ENGR.	

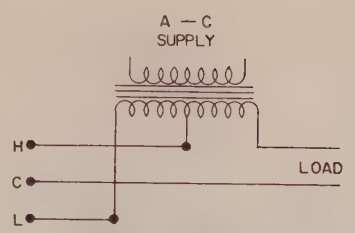
RO-AD 105



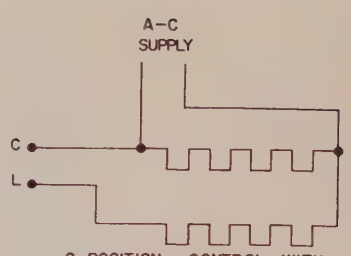
ON–OFF CONTROL
SOLENOID VALVE



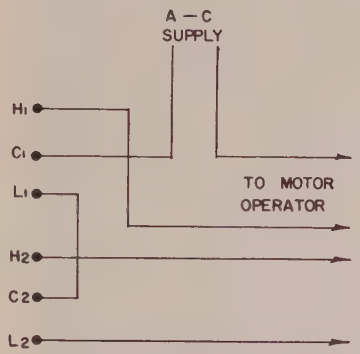
2 POSITION CONTROL FOR
SMALL ELECTRIC FURNACES



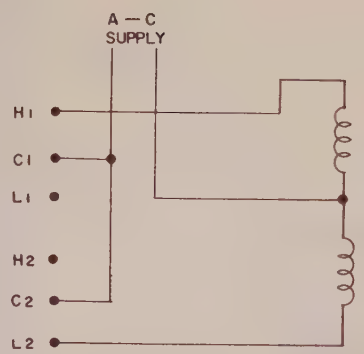
2 POSITION CONTROL WITH
TAPPED TRANSFORMER



2 POSITION CONTROL WITH
2 HEATING UNITS



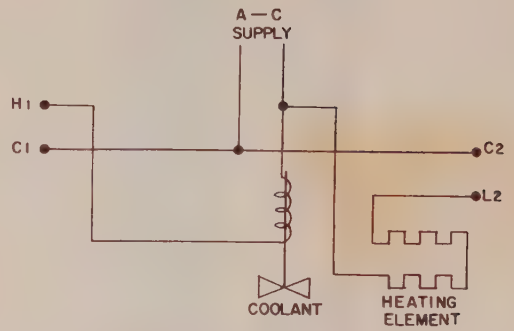
3 POSITION CONTROL WITH
MOTOR DRIVEN VALVE



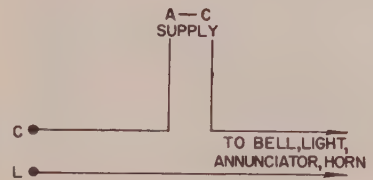
CONTACT CLOSURE

BELOW CONTROL POINT	AT CONTROL POINT	ABOVE CONTROL POINT
C2 L2	NONE	C1 H1

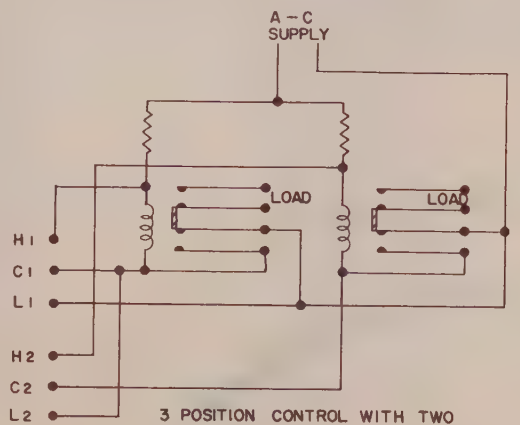
2 SETS OF CONTACTS PROVIDING
FLOATING CONTROL OF REVERSIBLE MOTOR



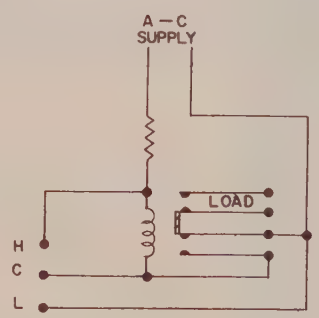
3 POSITION CONTROL OF
HEATING AND COOLING



LOW ALARM WIRING



3 POSITION CONTROL WITH TWO
3 WIRE RELAYS



ON–OFF OR 2 POSITION
CONTROL WITH 3WIRE RELAY

NOTE:
C–L CONTACTS CLOSED
WHEN INPUT IS BELOW
SETPOINT VALUE

CONTROL WIRING, 10 TYPICAL INSTALLATIONS.

STANDARD MULTI-POINT CONTROLLER SCALES

For Potentiometer Instruments

CALIBRATION AND RANGE (DEGREES)	MIN. SCALE DIV. (DEGREES)	NO. OF DIV.
COPPER CONSTANTAN (ISA-T)		
-300 to + 300 F	*	100
0 to + 300 F	5	60
0 to + 600 F	5	120
20 to + 220 F	2	100
-100 to + 50 C	1	150
-100 to + 100 C	2	100
-50 to + 100 C	1	150
-20 to + 90 C	1	110
-10 to + 60 C	1	70
10 to + 60 C	1	50
IRON CONSTANTAN (ISA-J)		
-100 to +1000 F	10	110
-100 to +1200 F	10	130
0 to + 400 F	5	80
0 to + 500 F	5	100
0 to + 600 F	5	120
0 to + 800 F	10	80
0 to +1000 F	10	100
0 to +1200 F	10	120
0 to +1500 F	20	75
0 to +1800 F	20	90
50 to + 350 F	5	60
100 to + 700 F	5	120
200 to +1200 F	10	100
500 to +1100 F	5	120
850 to +1050 F	2	100
-17.7 to + 650 C	5	120
0 to + 200 C	2	100
0 to + 300 C	5	60
0 to + 400 C	5	80
0 to + 600 C	5	120
0 to + 700 C	10	70
0 to + 800 C	10	80
40 to + 90 C	1	50
50 to + 250 C	2	100
75 to + 125 C	1	50
100 to + 200 C	1	100
155 to + 205 C	1	50
200 to + 600 C	5	80
200 to + 700 C	5	100
250 to + 450 C	2	100

CALIBRATION AND RANGE (DEGREES)	MIN. SCALE DIV. (DEGREES)	NO. OF DIV.
CHROMEL ALUMEL (ISA-K)		
0 to + 400 F	5	80
0 to + 600 F	5	120
0 to + 750 F	10	75
0 to + 800 F	10	80
0 to +1000 F	10	100
0 to +1200 F	10	120
0 to +1600 F	20	80
0 to +1800 F	20	90
0 to +2000 F	20	100
100 to +1800 F	20	85
600 to +1200 F	5	120
800 to +1800 F	10	100
0 to + 600 C	5	120
0 to + 700 C	10	70
0 to +1000 C	10	100
300 to +1200 C	10	90
350 to + 750 C	5	80
600 to +1200 C	5	120
PLAT. 13% RH. - PLAT. (ISA-R)		
200 to +2500 F	20	115
MILLIVOLTS		
-10 to + 100	1	100
-2.5 to + 2.5	.05	100
-1 to + 1	.02	100
0 to + 10	0.1	100

* Nonlinear calibration curve necessitates variation in minor graduations.

To determine approximate distance between dial divisions, divide number of divisions into scale length (5.5 inches). Because scales (except millivolt and uniform) are nonlinear, the calculated distance will vary over the scale length.

8-0 ADDENDUM

8-1 BRIDGE TYPE CONTROLLER MODEL 80216

8-1-1 General

Multi-Point Controllers utilizing resistance temperature detectors or other resistance type sensing elements differ from thermocouple type instruments in the following ways:

A. A resistance bridge measuring circuit replaces the potentiometer circuit.
B. The range card consists of four precision resistors instead of three.
C. The constant voltage supply is replaced by a DC bridge supply (not adjustable). Thermo-Electric part number 80328.
D. The reference junction compensating spool is eliminated.
E. Three terminals per input are provided for connecting the resistance temperature detector leads.

8-1-2 Installation

Installation procedure is identical to that specified previously for thermocouple type instruments, except three input terminals are provided for connecting each set of resistance temperature detector leads. Connect in accordance with the following table:

Terminal Designation	Lead Color
A	White
B	Red or Green
C	Black

Table 1

8-1-3 Calibration

Calibrate using a resistance bridge or resistance substitution box of known accuracy and the appropriate table for converting ohms to degrees. (Tables are available from Thermo-Electric Co., Inc. upon request. Please specify calibration curve.) Connect a lead from "A" input terminal on the instrument to one terminal on the substitution box. Connect individual leads from "B" and "C" input terminals respectively to the second substitution box terminal. Adjust calibration with the electrical zero adjust located on the instrument measuring circuit board.

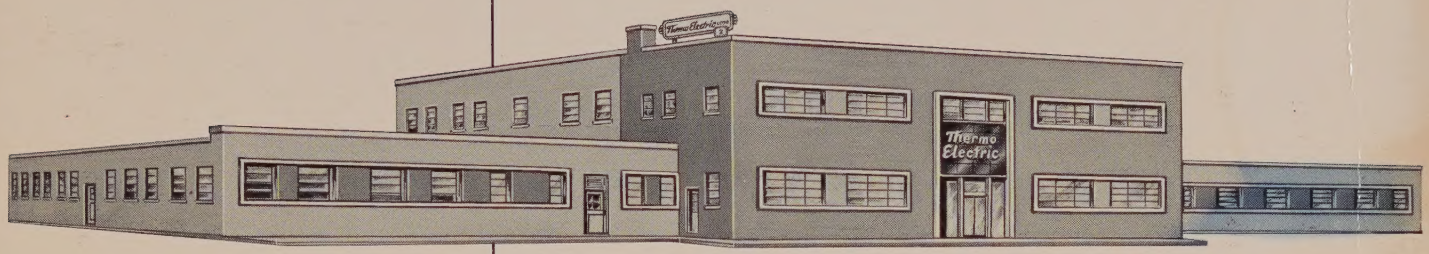
8-2 MILLIVOLT CONTROLLERS

8-2-1 General

Multi-Point Controllers calibrated in millivolts are identical to thermocouple instruments, with one exception. The reference junction compensating spool has been replaced with a manganin wound, non-temperature-sensitive precision resistor. Our standard potentiometer circuit is used in this type instrument.

8-2-2 Calibration

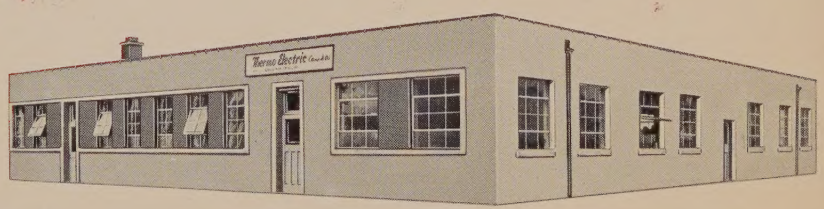
Calibrate by applying a millivolt signal from a calibrated source to the input terminals. Connections are made with copper wire.



Main Offices and Plant, Saddle Brook, New Jersey

Plant at Fair Lawn, New Jersey

Thermo Electric



Thermo Electric (Canada) Ltd., Brampton, Ontario, Canada

Printed in USA

Thermo Electric

THERMO ELECTRIC Co., Inc.

Saddle Brook, New Jersey